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DIGITAL TAPE UNIT TEST
FACILITY SOFTWARE

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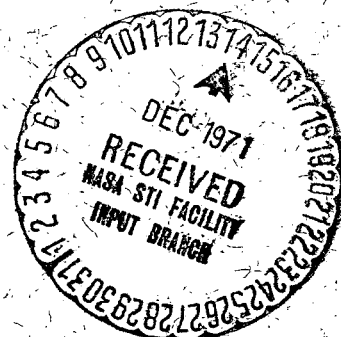
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GREENBELT, MARYLAND

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FOREWORD

This manual describes two computer sys-
tems currently used with the Digital Tape
Unit Test Facility (DTUTF), The DTUTF
Histogram Generating System and the
DTUTF Cardchecking and Tape Updating
System.

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ABSTRACT

The two computer programs described in this manual are used for
the collection and analysis of data from the Digital Tape Unit Test
Facility. The data are the recorded results of skew tests made on
magnetic digital tapes which are used on computers as input/output
media. The results of each tape test are keypunched onto an 80
column computer card. The format of the card is checked and the
card image is stored on a master summary tape via the DTUTF
Card checking and Tape Updating System. The master summary
tape containing the results of all the tape tests is then used for
analysis as input to the DTUTF Histogram Generating System which
produces a histogram of skew vs. date for selected data, followed
by some statistical analysis of the data.

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CONTENTS (continued)

DIGITAL TAPE UNIT TEST FACILITY SOFTWARE

Section 1

THE DTUTF HISTOGRAM GENERATING SYSTEM

1.1 INTRODUCTION

The DTUTF Histogram Generating System is a program which uses the DTUTF data tapes to perform both statistical analysis and plotting. It plots tape character skew (in microseconds) vs. date (in Julian weeks) for a selected tape drive, tape, or for all the drives on a computer, and displays the histogram on either the IDIIOM graphic display or the printer (or both upon selection). The results of the statistical analysis are printed below the histogram.

This program was designed for the CDC 3200 (16 k memory) interfaced with the IDIIOM graphic display (4 k memory). The CDC 3200 coding was written in Fortran IV in the form of a main program and three subroutines; the IDIIOM coding was written in the assembly language, IDAS, and is stored in one of the subroutines.

This system has been used for several months, and its applications have been found mainly in the realm of quality assurance. Both the quantity and the quality of the maintenance of the write heads on the digital tape drives are evident upon inspection of the appropriate histogram.

1.2 BACKGROUND

The Digital Tape Unit Test Facility (DTUTF) is the source of the data for the DTUTF Histogram Generating System. The DTUTF receives both routine maintenance write performance test tapes and special problem tapes from almost all the computers on the Goddard Space Flight Center and several from outside the Center. The DTUTF tests tapes for:

1. Bits in interrecord gap (irg.) or short irg.

2. Excessive packing density.

3. Asymmetry problems.

4. Physical damage.

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5. Marginal tapes, i.e., those with a skew of four microseconds or those with format errors.

6. Unacceptable tapes, i.e., those with a skew of five microseconds or with many format errors.

7. Tape acceleration.

8. No end of file marker.

9. Poor or "wavy" oxide coating.

10. Inability of the DTUTF to read the tapes.

The results of the tests along with the identification of the tapes are typed on computer cards and stored on magnetic tape. The following example illustrates the format.

DATE GENERATED	SOURCE	ID	DENSITY	PARITY	SKEW	SKEW ERRORS	AMP P-P	TAPE BRAND	COMMENTS
08/01/70	1108 7/1	AT8178	556	ODD	2.5	0	8.0	IBM	R

The field labels (DATE GENERATED, SOURCE, ID, etc.) are defined as follows:

1. The DATE GENERATED is the date the tape was written.

2. The SOURCE is the computer source and tape drive or facility used to generate the tape.

3. The ID is the tape identification number assigned by the Digital Tape Accounting (Code 565).

4. The DENSITY is the packing density of the data characters recorded on tape. (This is not necessarily the manufacturer's certified density.)

5. The PARITY is the lateral parity of the recorded data characters which is either odd or even.

6. The SKEW refers to the minimum DTUTF read window setting in microseconds necessary to reliably read the tape. The skew is measured using a tape speed of 112.5 ips, hence skew x 112.5 = skew in microinches.

7. SKEW ERRORS refers to the number of tape records containing skew values equal to or greater than the skew setting.

8. AMP P-P is the peak-to-peak amplitude of the read head signal measured at the output of the DTUTF 729-VI tape handler read amplifier.

9. TAPE BRAND refers to the manufacturer. They are labeled using the following code:

   A. A = AMPEX

   B. AT = AUDIO TAPE

   C. IBM = IBM

   D. RCA = RCA

   E. S = SCOTCH

   F. MEM = MEMOREX

   G. SC = SOUNDCRAFT

   H. AU = AUDIO

   I. US = US TAPES

   J. GM = GRAHAM MAGNETICS

10. COMMENTS refers to a number code from one to ten which represents whichever of the ten DTUTF tests the tape failed under. Also, valid comments include:

   A. E = Tapes that have been returned from experimenter

   B. R = Rehab tapes

Thus the DTUTF has both extensive testing capability and good documentation of tests made. Because the data is both rigidly formatted and computer accessible, large scale data selection and analysis can be obtained readily through elementary Fortran programming.

In recent months, the DTUTF has had many requests concerning cumulative past performance of tape drives. In response to these requests, the DTUTF Histogram Generating System was written and added to the DTUTF software.

1.3 BLOCK DIAGRAM AND SYSTEM DESCRIPTION

Figure 1 is the block diagram for the system. This system is essentially four independent programs which share a common area of data. Because of the memory size of the CDC 3200 (16 k), the program was written using overlays. This is an operational technique whereby several programs, which will not fit into memory together, are loaded onto tape, then, one at a time, loaded into a specified part of memory, executed, and destroyed when the next overlay is loaded into that same part of memory. The main program is the workhorse of the system having the chore of data processing, while overlays one and two merely display the processed data on the printer and the IDIIOM respectively, and overlay three generates a title page and the operating instructions. Figure 2, the data flow of the system, shows the work distribution in more detail.

The main program has five functions. First, it accepts the user's input selections and output options via the console typewriter or the card reader. The input selections are, in effect, the user's description of the equipment and the time period for which a histogram is desired. For instance, a computer, tape drive, and a month may be selected. This will cause a histogram of that particular tape drive during that particular month to be generated. If no tape drive were specified, all the tape drives for that computer would be reflected in the histogram. There are three output options which may be selected, the printed histogram, the IDIIOM histogram, and the printed data card images. These may be selected in any combination.

The second function of the main program is the data search. Here, each card image on tape is compared with the input selection parameters. If a match is found, the values of date and skew are stored in a two dimensional array in a common data area. Then the skew value is processed for maximum, minimum, mean, and standard deviation preparation. If the "print data cards" option was selected, the card image (in the format described in 1.2) is printed. Then, the read-compare cycle is repeated until an end-of-file character is reached on tape.

When an end-of-file is sensed, the selected overlays (output options) are called. First, the IDIIOM option is processed if selected, and the histogram is displayed on the screen. Next, the printer option is processed if selected, and the histogram is printed. The calling of these overlays constitutes the third function of the main program.

Statistical analysis, the fourth function, takes place next. Here, the maximum skew, minimum skew, mean skew, standard deviation, and total number of tapes are computed and output along with the selected equipment description, on the printer. This printing marks the end of one run.

The fifth function, that of reinitialization, now occurs. The data tape is rewound, the counters used in statistical analysis are reset, and the system prepares itself to accept new input selections and options from the operator.

Overlay 1 is a program which takes the two dimensional array in the common data area which was assembled by the main program (representing skew vs. date) and converts points in the array into points on the histogram. These, along with the appropriate labels, are printed on the printer, and system control is returned to the main program.

Overlay 2 is a program which takes the skew vs. date array and converts the points in the array into points on the IDIIOM screen. Also, labels and coordinates are displayed on the screen. This completed, control is returned to the main program; however, the histogram remains on the screen.

Overlay 3 is a short program which prints the title page, "Digital Tape Drive Analysis," and types the operating instructions on the console typewriter.

1.4 HISTOGRAM APPLICATIONS

The DTUTF histograms would probably be most useful as documentation for quality assurance, since both the regularity and the stringency of this particular kind of maintenance can be seen on the histograms.

First, the regularity of maintenance is evident upon inspection. Compare Figure 3 with Figure 4. Figure 3 shows that computer X has never missed a week of write performance testing, while Figure 4 shows that for periods as long as six weeks not one test was made on any tape drives of the computer Y. Furthermore, Figure 4 shows that during the eight month period from January through August 1970, there were no tests made on a total of 19 weeks out of 35. Hence, for this particular computer, there has been no write head maintenance for more than 50% of its operation this year (1970).

A second quality assurance concern also immediately apparent on the histogram is the stringency of write head maintenance on the tape drives. Again, compare Figure 3 with Figure 4. On Figure 3 (computer X), the mean skew is 2.76 microseconds, while on Figure 4 (computer Y), the mean is 3.78 microseconds. Hence, a 1.02 microsecond difference exists between the standard of skew allowed on the computer X drives and the standard for the computer Y drives.

The histograms can also be used to predict problems by observing large deviations on particular drives. Consider Figure 5. This tape drive cannot be

depended on for low skew on the tapes it generates. It also accounts for many of the peaks on the histogram of computer X in Figure 3.

1.5 OPERATING INSTRUCTIONS

1. Put the object deck (in the format shown in Figure 6) in the card reader.

2. Push <u>Stop</u> on the CDC 3200 console.

3. Push <u>Master Clear</u> (MC) on the CDC 3200 console.

4. Push autoload on the CDC 3200 console.

5. When the typewriter types "Date," type in the date (MMDDYY), then push <u>Finish</u>.

6. When the typewriter types "Time," type in the time (TTTT), then push <u>Finish</u>.

7. After the typewriter types:

   Sequence, 007

   JOB, JTJ, 60

   05 = MT, C 1, E 0, U 03

   04 = MT, C 1, E 0, U 02

   READY ?

   Set the tape drives as specified in the typewriter message, with a scratch tape on MTC1E0U02 and then press <u>Finish</u>.

8. The program will be loaded, and the overlay tape generated. When this is completed, the console typewriter types:

   Run, 3

   Operating Instructions.

   Mount Data Tape on MTC1E0U03.

   Sense Switch 1 will stop a Data Search.

   A Mode Card Must Appear After Run Card.

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To Eliminate Instructions, Set sense switch 2 on before run.

Pause 00001 Press MI/MI to continue.

A. The data tape refers to the tape on which the DTUTF test accounting is stored.

B. The data search is the tape reading process. If immediate termination of a job is wanted, sense switch 1 is selected and the program is reinitialized; also the printer outputs "Job terminated by SJ1."

C. The first card after the program's run card determines whether the user's input will be from the typewriter or from the card reader. Either the word "card" or the word "type" must be typed in the first four columns of the mode card. If neither is typed, the typewriter types, "Illegal mode card. Correct, reinsert, ready reader," followed by, "Pause 00002. Press MI/MI to continue." After the corrections are made, the user presses Interrupt on the console, "/" on the typewriter, and Interrupt on the console again.

D. If sense switch 2 is turned on before the program is run, no operating instructions will be printed.

Read the instructions, then press Interrupt on the console, "/" on the typewriter, and Interrupt on the console. This causes the mode card to be read.

9. A. If the mode is "type," the input selection begins with the typewriter typing "MO/DA/YR type 8 characters." The month and day must have leading zeroes when only one digit applies. If all the values for a particular year, month, or day are desired, type blanks (skip spaces) in the field which would otherwise delimit the data. For instance, if all the values for one year were desired, the user would type six blanks followed by two digits which could represent the year. Press Finish. If an inappropriate number was entered in any of the fields, the typewriter repeats "MO/DA/YR type 8 characters."

B. Next the typewriter types "computer and/or channel." Type in the type of computer (1108, 3200, 7010, etc.), a blank, and the channel and equipment number of the tape drive (7/1, 9/6, 11/2, etc.). Press Finish. If a histogram showing the cumulative performance of all the drives on a computer is desired, select only the computer and leave the rest blank. Press Finish.

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C. Next the computer types "GSFC account number." Usually this is ignored and the user presses Finish. However, if a particular tape is being studied, enter the GSFC account number (found on the tape) and press Finish.

D. The computer then types "options (D/P/I). Type 5 characters." These represent the output options. They are coded such that

    (i)   D = Print Data Card Images

    (ii) P = Printed Histogram

    (iii) I = IDIIOM Histogram

Any or all 5 characters may be typed or left blank as long as the first character is a D or a blank, the third character is a P or a blank, and the fifth character is an I or a blank. Press Finish.

E. Finally the computer types, "Is the above data correct? (Y or N)" Type Y (yes) or N (no). Press Finish. If N is typed, the entire typewriter input selection is begun again. If Y is typed, the data search (tape reading) is begun. After the data search, the output options are executed and the typewriter begins again the input selection.

10. If the mode was card, the card reader reads one card with all the input parameters on it. They are formatted in the following manner:

Column	2-3	4	5-6	7	8-9	11-20	21-26	30	32	34
Parameter	MO	/	DA	/	YR	computer chan/equip	account No.	D	P	I

11. If the IDIIOM option was selected, certain preparations must be made.

A. The IDIIOM must be turned on.

B. The IDIIOM's computer, the Varian 620/i, must have the following programs in memory:

    (i)   Paper tape loader bootstrap.

    (ii) Binary load and dump.

    (iii) Varian program loader.

    Note: These programs usually are in memory.

C. The registers must be cleared.

D. P register must be set to 740_8.

E. The system reset button must then be pushed.

F. The run button is pushed last.

It should be noted that the IDIIOM preparations do not have to be made if the IDIIOM option is not selected. Figure 7 shows the IDIIOM Histogram for computer X.

Section 2

THE DTUTF CARDCHECKING AND DATA TAPE UPDATING SYSTEM

2.1 INTRODUCTION

The DTUTF Cardchecking and Data Tape Updating System is a program which can either check the format of the DTUTF data cards or put new cards on the DTUTF data tape. It was written for two reasons. First, a format standard was needed. The cardchecking routine tests all the new data cards against this standard. Second, consolidation was needed. This system replaces several small utility programs and also gives data tape updating capabilities.

The program was written for the CDC 3200 in Fortran and uses less than 1/3 of the 16 K memory. It types its operating instructions, and its operating time is only limited by the speed of the I/O peripherals.

Having data both standardized and assembled opens the door to analysis. The DTUTF histogram generating system (Section 1) is the first such analysis of these data. However, since each data card contains fourteen pieces of information, many other analytical studies can be made.

2.2 BACKGROUND

The testing done by DTUTF (described in section 1.2) was, until recently, documented in a loosely formatted manner. With interest growing in the area of DTUTF data analysis, it became necessary to set up a standard for the format of the data cards. The DTUTF data card must now conform to the following format standard:

Column	Data Entry
1	A blank indicates a data card An * indicates a comment card An E indicates an end of file
2-3	The month with leading zeroes where necessary (01, 02, ..., 12)
4	A slash (/)
5-6	The day with leading zeroes where necessary
7	A slash (/)

Column	Data Entry
8-9	The year (68, 69, 70)
10	A blank
11-20	Computer followed by a blank, channel/ equipment No.
21-26	GSFC tape account number
27-30	Four blanks
31-33	Density 200, 556, 800
34-38	Five blanks
39-42	Parity odd or even
43-45	Three blanks
46-48	Skew from 0.0 to 8.0 in 0.5 increments
49-54	Six blanks
55-58	Number of skew errors (enter any number left justified)
59	Blank
60-62	Amplitude peak-to-peak. Enter an integer in col. 60, a decimal point in col. 61, and another integer in col. 62.
63-66	Four blanks
67-69	Tape brand (see tape brand code section 1.2) left justified
70-71	Two blanks
72-80	Comments (see comment code section 1.2) left justified

If an entry is to be omitted, a dash (-) must be typed left justified in the field.

The DTUTF data cards are first used to generate the DTUTF weekly and monthly reports, then they are stored on magnetic tape. An example of a data card is in section 1.2.

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2.3 DATA FLOW AND SYSTEM DESCRIPTION

Figure 7 shows the data flow for the DTUTF cardchecking and data tape updating system. The program operates in two modes which implement either card checking or tape updating. The user selects the mode via the console typewriter.

If the cardchecking mode is selected, each card is read, written on tape, and tested against the format standard described. If the card fails any test, it is printed with an "improper format" tag. These bad cards can be printed along with the other cards and flagged as errors, or printed separately along with their physical location in the deck as a set of bad cards. If some improperly formatted cards are discovered, they should be corrected, reinserted in the reader, and processed again since the computer will be reinitialized after every run.

2.4 OPERATING INSTRUCTIONS

Step 1. Run program in the structure shown in Figure 9 on CDC 3200 in the manner of steps 1-7 in Section 1.5.

Step 2. Typewriter types update or cardcheck (U or C).

Step 3. Answer U or C on typewriter, then push finish. If C was typed, go to step 4. If U was typed, go to step 7.

Step 4. If C was typed, operating instructions for the card checking routine are typed.

    A. "Operating Instructions."

    B. "Sense switch 1 on for error print only."

    C. "Sense switch 2 on for extra copies."

    D. "Pause 00002. Press MI/MI to continue."

Step 5. Select sense switch options, then press MI/MI to continue.

Step 6. Program processes deck, writes card images on MTC1E0U01, prints according to sense switch 1 options, and searches for an E in the first column of the cards in the deck. After finding an E, it writes total number of errors in above list = total, and checks for sense switch 2 which allows 20 extra copies to be made. If fewer

copies are desired, turn off sense switch 2 while last copy is being printed, and that copy will be completed, then return to step 2.

Step 7. If U was typed in step 3, operating instructions for the tape updating routine are typed.

    A. "Operating instructions."

    B. "Mount data tape on MTC1E0U01."

    C. "Put new data cards in card reader."

    D. "New data tape generated on MTC5E0U02."

    E. "Pause 00001 Press MI/MI to continue."

Step 8. Follow the instructions generated in step 7, and when tape and cards are ready, press MI/MI to continue.

Step 9. When the new tape is complete, both the new tape and the old tape will rewind, then the program returns to step 2.
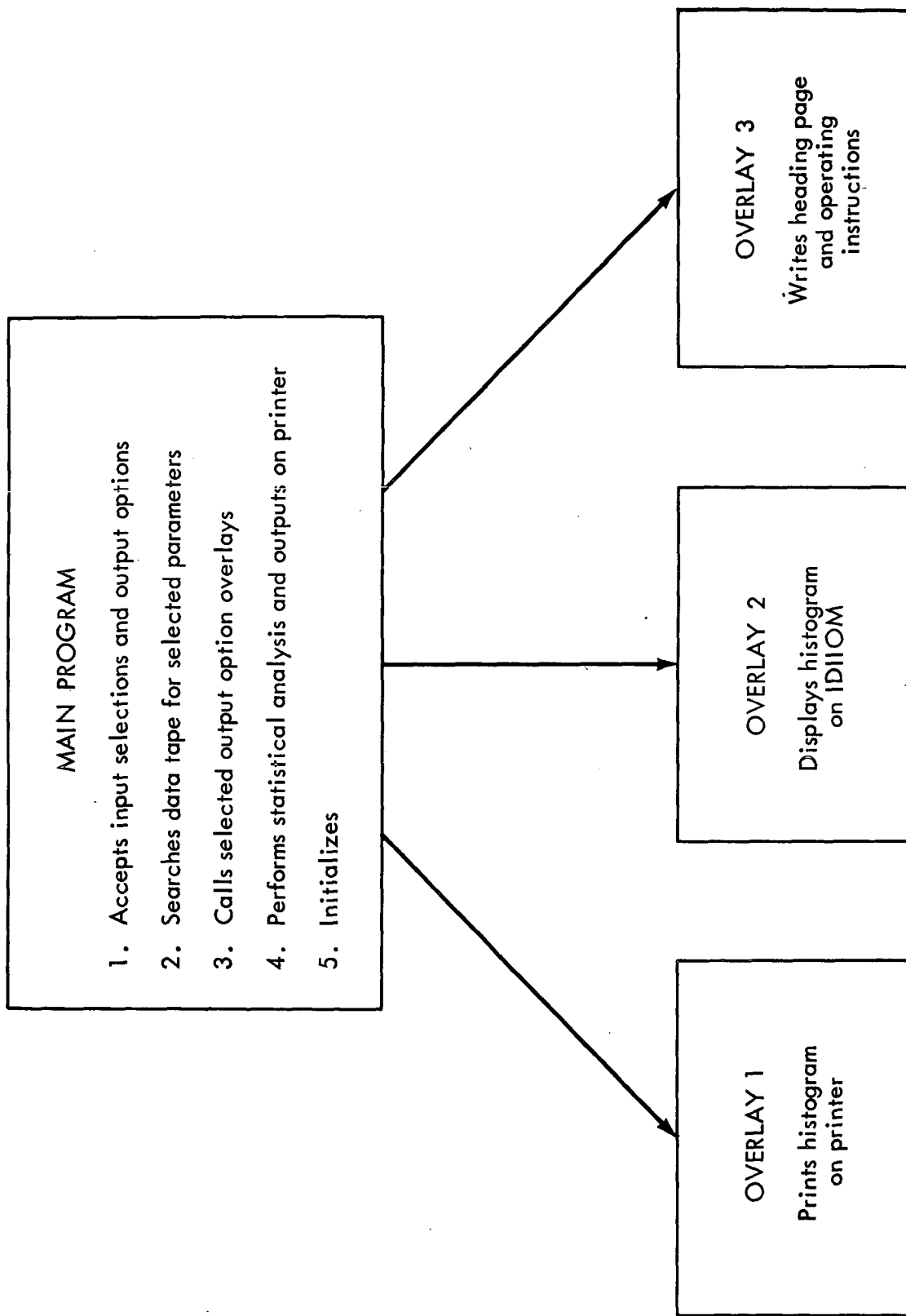
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Section 3

DIAGRAMS

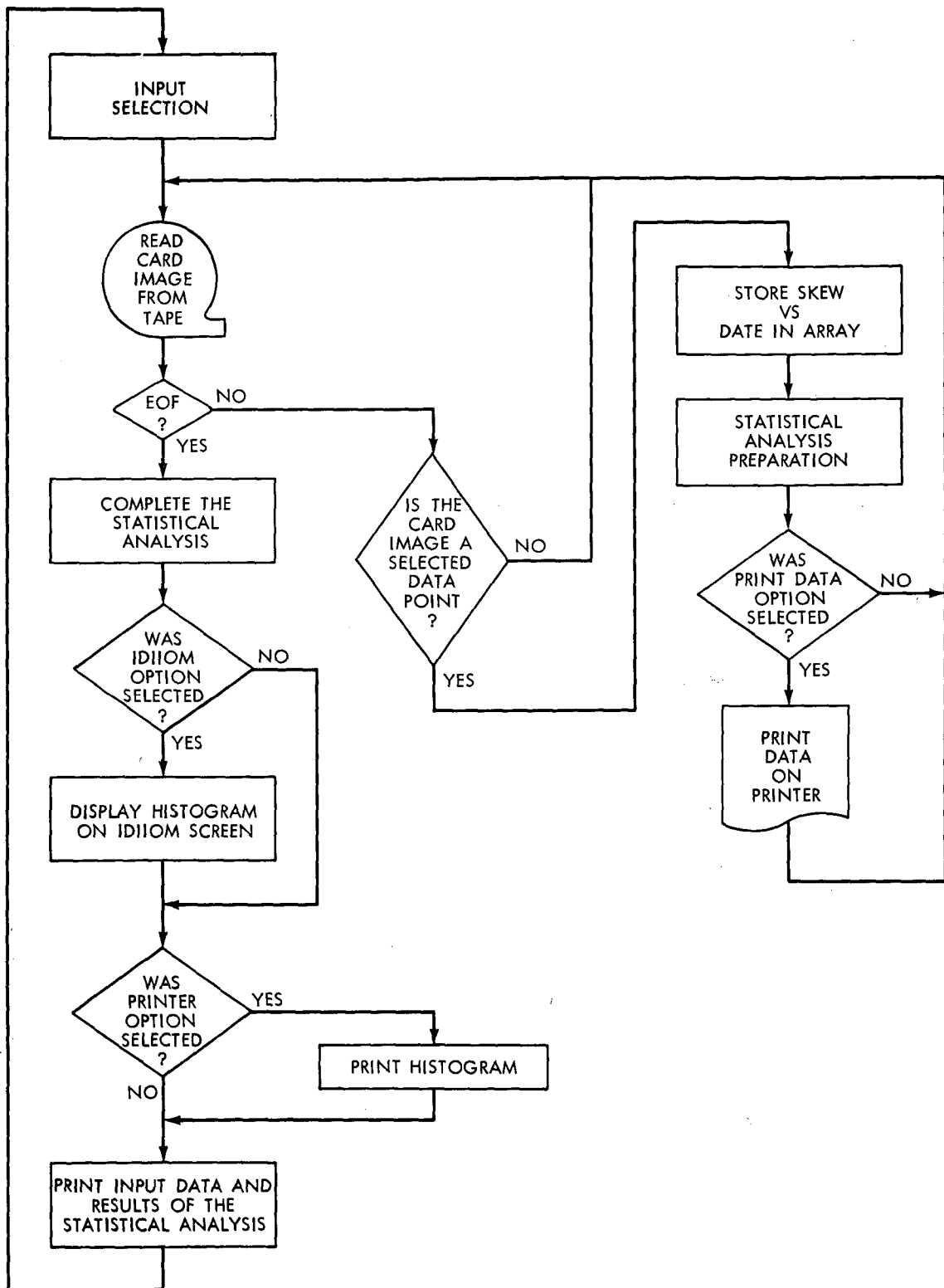Figure 1. Block Diagram of DTUTF Histogram Generating System

MAIN PROGRAM

1. Accepts input selections and output options

2. Searches data tape for selected parameters

3. Calls selected output option overlays

4. Performs statistical analysis and outputs on printer

5. Initializes

OVERLAY 3

Writes heading page and operating instructions

OVERLAY 2

Displays histogram on IDIIOM

OVERLAY 1

Prints histogram on printer

Figure 2. Data Flow for DTUTF Histogram Generating System

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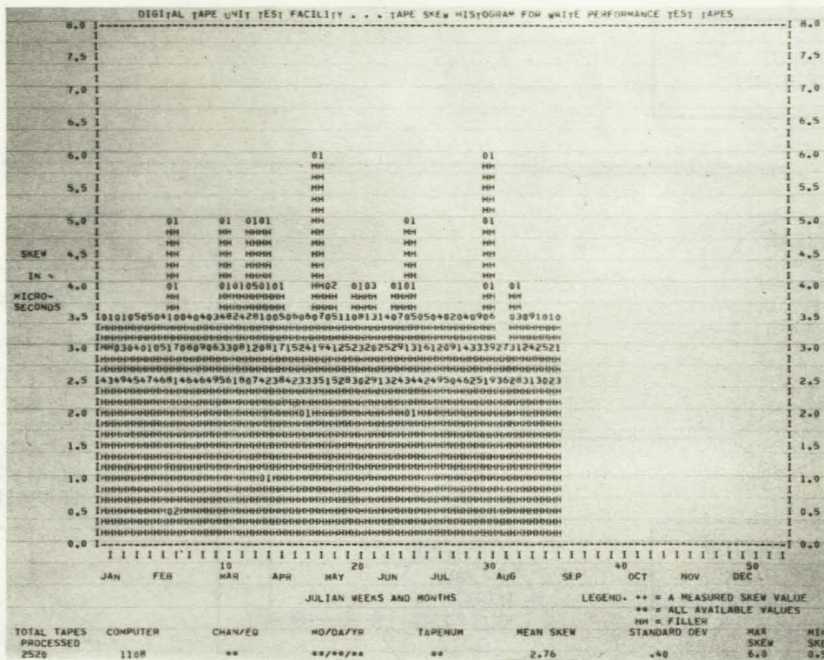
Figure 3. Histogram for Computer X
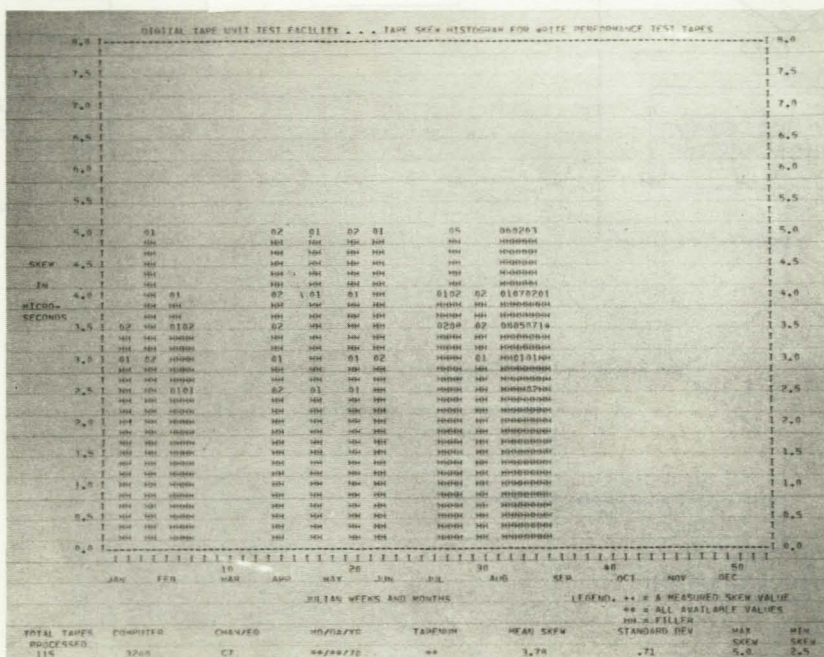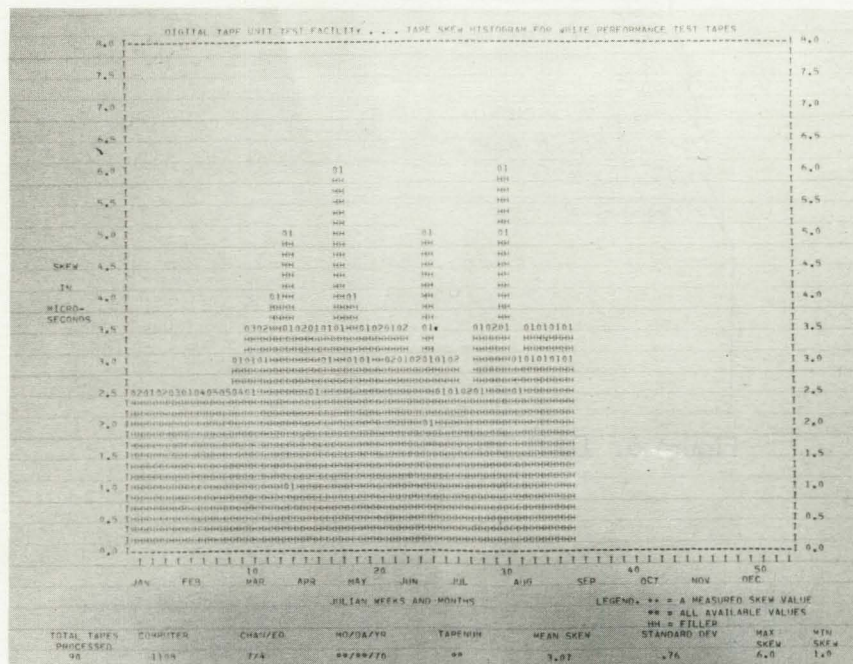
Figure 4. Histogram for Computer Y

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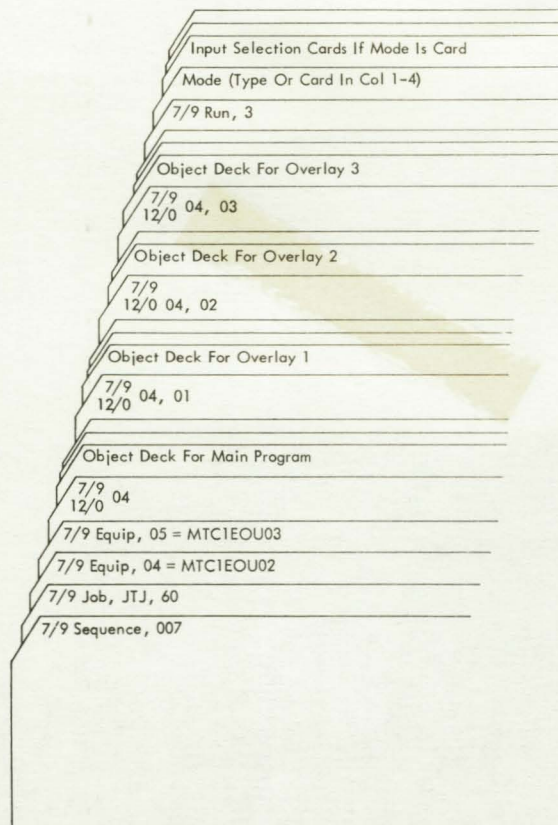Figure 5.   Histogram for a Particular Tape Drive
on Computer X

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Input Selection Cards If Mode Is Card

Mode (Type Or Card In Col 1-4)

7/9 Run, 3

Object Deck For Overlay 3

7/9
12/0 04, 03

Object Deck For Overlay 2

7/9
12/0 04, 02

Object Deck For Overlay 1

7/9
12/0 04, 01

Object Deck For Main Program

7/9
12/0 04

7/9 Equip, 05 = MTC1EOU03

7/9 Equip, 04 = MTC1EOU02

7/9 Job, JTJ, 60

7/9 Sequence, 007

Figure 6. Deck Structure for DTUTF Histogram Generating System
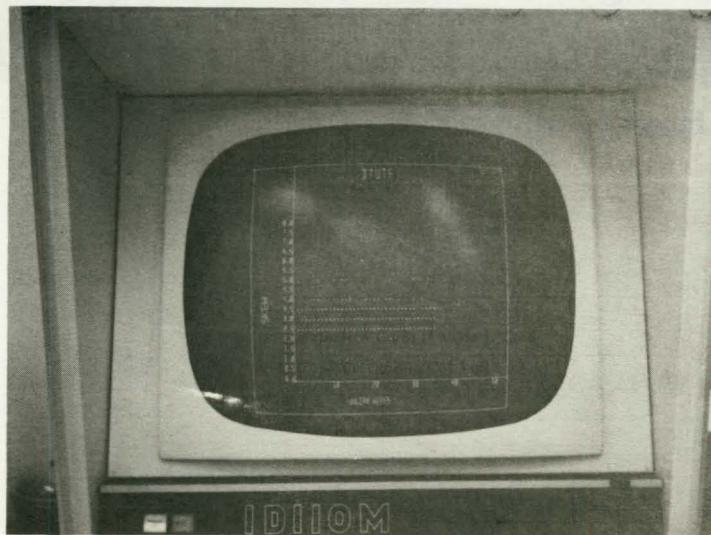

Figure 7. IDIIOM Histogram for Computer X

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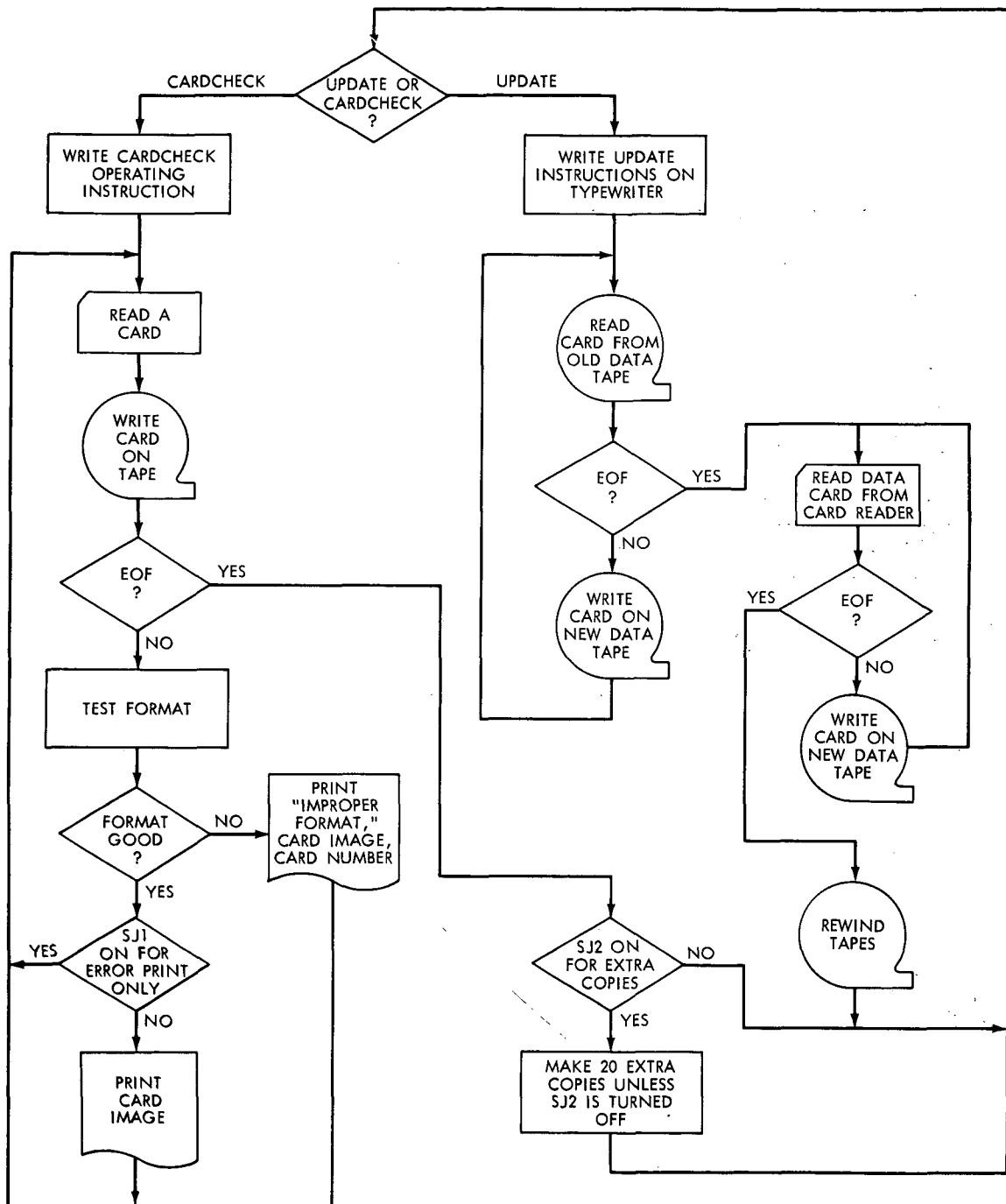
Figure 8. Data Flow for DTUTF Cardchecking and Data Tape Updating System

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7/9 Run, 3

Object Deck For Program

7/9 Equip, 55 = MTC1EOU01, 05 = 55

7/9 Equip, 56 = MTC5EOU02, 06 = 56
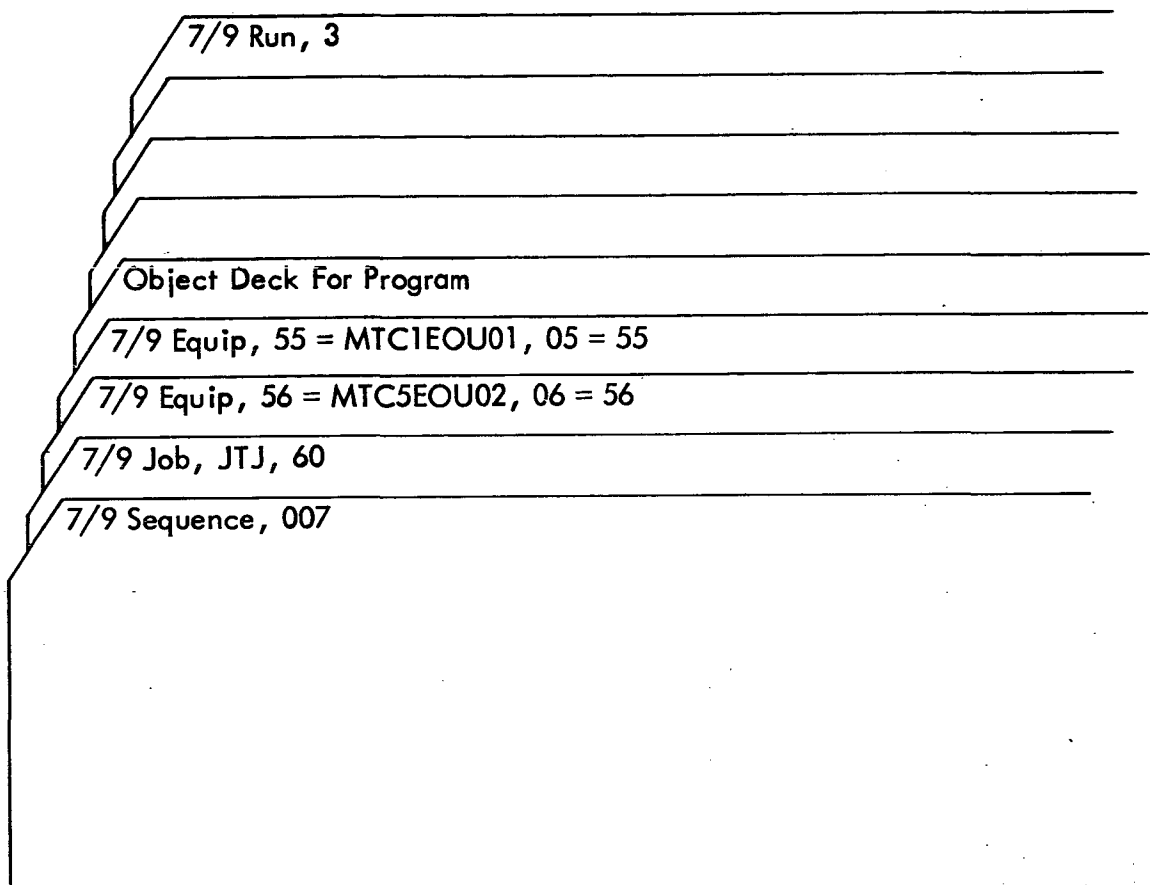
7/9 Job, JTJ, 60

7/9 Sequence, 007

Figure 9. Deck Structure for DTUTF Cardchecking and Tape Updating System